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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/675,627	09/29/2000	Michael Rumer	M-8570 US	9578

34036 7590 04/06/2005

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EXAMINER

PERKINS, PAMELA E

ART UNIT	PAPER NUMBER
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2822

DATE MAILED: 04/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary	Application No. 09/675,627	Applicant(s) RUMER ET AL.	
	Examiner Pamela E. Perkins	Art Unit 2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 January 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7, 9-24, 26 and 28-30 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 9-17 is/are allowed.
- 6) ☒ Claim(s) 1-7, 18-24, 26 and 28-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This office action is in response to the amendment filed on 18 January 2005.

Claims 1-7, 9-24, 26 and 28-30 are pending; claims 8, 25 and 27 have been cancelled.

Claim Objections

Claims 26 and 28 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 2, 4, 23 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngan et al. (5,943,600) in view of Freeman et al. (5,466,522).

Ngan et al. disclose a method of forming a titanium layer on a substrate where the substrate is placed in a deposition chamber comprising a source of titanium (col. 3, lines 16-34); and depositing a titanium layer onto the substrate by physical vapor deposition of the source of titanium under conditions wherein the atmosphere in the deposition chamber comprises hydrogen (col. 3, lines 35-60); depositing a titanium nitride layer (34) on the titanium layer (32); and depositing an aluminum layer (36) on

the titanium nitride layer (34) (col. 4, lines 42-54; col. 5, lines 42-49). Ngan et al. do not disclose wherein the atmosphere in the deposition chamber comprises hydrogen in a concentration of at least 0.1 molar percent.

Freeman et al. a method of forming a layer over a substrate where a substrate is placed in a sputter chamber containing a gas mixture of argon (inert gas) and hydrogen in the atmosphere and sputter depositing a layer over the substrate. Freeman et al. further disclose the gas mixture comprising at least 4 mole percent hydrogen (col. 4, lines 7-57).

Since Ngan et al. and Freeman et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Freeman et al. would have been recognized in the pertinent art of Ngan et al. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Ngan et al. by the gas mixture during sputter deposition comprising at least 4 mole percent hydrogen as taught by Freeman et al. The higher the concentration of hydrogen in the atmosphere during sputter deposition there is an increase in the coercivity of the film formed on the substrate, meaning the polarity of the material changes only under the influence of a relatively large magnetic field (col. 7, lines 7-57).

Referring to claim 2, Ngan et al. disclose the source of titanium as a sputtering target and wherein depositing the titanium layer onto the substrate is sputter depositing the titanium layer by applying power to the sputtering target (col. 3, lines 49-60).

Referring to claim 29, Ngan et al. disclose the claimed invention except for absorbing the hydrogen to a depth of about 50 Angstroms into the titanium target. It

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would have been obvious to one having ordinary skill in the art at the time invention was made to absorb the hydrogen to a depth of about 50 Angstroms into the titanium target, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA.1955).

Claims 3, 5, 18, 20, 21 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngan et al. in view of Freeman et al. and Yamadai (6,083,830).

Ngan et al. in view of Freeman et al. disclose the subject matter claimed above except the titanium layer having a <002> orientation, the titanium nitride layer having a <111> orientation and the aluminum layer having a <111> orientation.

Yamadai discloses a method of forming a layer on a substrate where a titanium layer (3), with a <002> orientation, is sputter deposited on a substrate (1), then a titanium nitride layer (4), with a preferred <111> orientation, is formed on the titanium layer (3) and an aluminum layer (5), with a <111> orientation, is formed on the titanium nitride layer (4) (col. 3, line 17 thru col. 5, line 41; col. 5, lines 1-33).

Since Ngan et al. and Yamadai are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Yamadai would have been recognized in the pertinent art of Ngan et al. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Ngan et al. by the titanium layer having a <002> orientation, the titanium nitride layer having a <111> orientation and the aluminum layer having a <111> orientation as

taught by Yamadai. A titanium layer with a <002> orientation prevents the formation of side-hole, openings in the sidewalls (col. 2, lines 21-55).

Referring to claim 5, Freeman et al. further disclose the gas mixture comprising at least 4 mole percent hydrogen (col. 4, lines 7-57).

Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngan et al. in view of Freeman et al. in view of Yamadai as applied to claims 1, 2 and 3 above, and further in view of Kaloyeros et al. (6,139,922).

Ngan et al. in view of Freeman et al. in view of Yamadai disclose the subject matter claimed above except applying powering to the target with a power density of 0.01 W/cm² to 10 W/cm².

Kaloyeros et al. disclose a method of forming a film over a substrate by a method of sputtering. Kaloyeros et al. further disclose the power used in the sputtering method having a power density of between 0.01 W/cm² and 10 W/cm² (col. 10, lines 60-67; col. 11, lines 1-17).

Since Ngan et al. and Kaloyeros et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Kaloyeros et al. would have been recognized in the pertinent art of Ngan et al. Therefore, it would have obvious to one of ordinary skill in the art at the time the invention was made to modify Ngan et al. by applying powering to the target with a power density of 0.01 W/cm² to 10 W/cm² as taught by Kaloyeros et al. Under such conditions undesirable film contamination and electrical damage to the film are prevented (col. 11, lines 1-17).

Claims 19 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngan et al. in view of Freeman et al. in view of Yamadai as applied to claims 18 and 20 above, and further in view of Hsu et al. (6,329,282).

Ngan et al. in view of Freeman et al. in view of Yamadai disclose the subject matter claimed above except the aluminum layer having a FWHM of 1.5 degrees.

Hsu et al. disclose a method of forming a titanium (9), titanium nitride (11), aluminum (19) interconnect. Hsu et al. further disclose the aluminum layer having a FWHM of 1.5 degrees (col. 3, lines 11-65).

Since Ngan et al. and Hsu et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Hsu et al. would have been recognized in the pertinent art of Ngan et al. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Ngan et al. by the aluminum layer having a FWHM of 1.5 degrees as taught by Hsu et al. because it improves the crystallographic orientation of the aluminum layer.

Hsu et al. do not disclose the aluminum layer having a FWHM of less than 1.5 degrees. It would have been obvious to one having ordinary skill in the art at the time invention was made to have a FWHM of less than 1.5 degrees for the aluminum layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Claims 25-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngan et al. in view of Freeman et al. in view of Kitch et al. (6,277,726).

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Ngan et al. in view of Freeman et al. disclose the subject matter claimed above except forming an aluminum layer and forming a titanium nitride layer.

Kitch et al. disclose a method of forming a titanium layer on a substrate where a substrate (12) is placed in a deposition chamber comprising a source of titanium, depositing the titanium layer (13) onto the substrate in an atmosphere that comprises argon, then forming an aluminum layer (16) on the titanium layer (13). Kitch et al. further disclose forming a titanium nitride layer (15) over the titanium layer (13) (col. 5, lines 6-30).

Since Ngan et al. and Kitch et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Kitch et al. would have been recognized in the pertinent art of Ngan et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Ngan et al. by forming the titanium layer by forming an aluminum layer and forming a titanium nitride layer by Kitch et al. to reducing the resistance of electrical coupling between conductive layers (col. 1, lines 8-11).

Allowable Subject Matter

Claims 9 and 10 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: prior art does not anticipate, teach, or suggest after placing the substrate in the deposition chamber introducing a quantity of hydrogen into the deposition chamber without providing power to the target.

Claims 11-17 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: prior art does not anticipate, teach, or suggest a method of forming a titanium layer on a substrate where the substrate is placed in a sputtering chamber comprising a titanium target, flowing a first gas comprising hydrogen into the sputtering chamber through a first gas injector, terminating the flow of the first gas, after the flow of the first gas has been terminated, sputter depositing the titanium layer onto the substrate by applying power to the target and by providing a second gas in the sputtering chamber through a second gas inject, wherein the hydrogen is activated and whereby the deposited titanium layer has a preferred crystal orientation.

Response to Arguments

Applicant's arguments with respect to claims 1-8 and 18-30 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within

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TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E. Perkins whose telephone number is (571) 272-1840. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

PEP


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